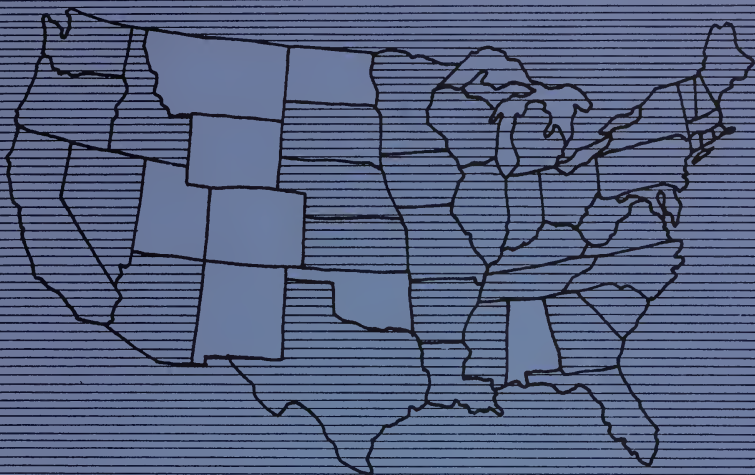


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Guidelines for Reclamation Study Areas

EMRIA HANDBOOK 1977



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FOREWARD

This handbook is a general guide for those involved in studies of the various aspects of reclamation problems and potentials of lands under consideration for surface coal mining or other major land disturbing activities. It is intended primarily as a guideline to those preparing requests for proposals for negotiated procurement of studies on specific sites. It is incomplete and is expected to be modified and expanded as more experience is gained in the evolving technology of disturbed land reclamation.

The Denver Service Center EMRIA Staff believes such a document is needed at this time to provide a common point of reference in the highly decentralized evolving EMRIA program.

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INTRODUCTION

The EMRIA program was promulgated to expedite acquisition of information on reclamation potentials needed for surface coal mine lease site selection decisions and development of stipulations that will assure accomplishment of realistic reclamation goals.

The program is intended to compliment, rather than duplicate or replace, the established resource inventory, management planning, or impact evaluation systems, i.e., URA, MFP, EIS, etc. Its objective is to provide, on a timely basis, needed reclamation information not available from other sources.

The program is focused on surface coal mine related activities but is applicable to other major land disturbing activities as needs and priorities will allow.

This handbook outlines the rationale and procedures that have evolved in the short time the program has been in effect. It is not intended to be used as a cookbook of detailed HOW-to-do-it "recipes", but rather as a guide that outlines a rational sequence of key activities, i.e., WHAT to do. Part I deals with the identification of information needs and formulation of plans for their acquisition. Part II pertains to data gathering procedures. Part III addresses report development content and format.

PART I - INFORMATION NEEDS IDENTIFICATION AND STUDY PLANS

The consensus of views expressed by line managers and staff people directly involved in the coal leasing program indicates that they need ANSWERS to three basic questions:

- A. Can the area be effectively reclaimed?
- B. What are the major problems involved in reclamation of the area?
- C. What reclamation measures are necessary to establish the desired post-mining conditions?

Acquisition of the information to answer these questions, specifically omitting information presently available, is therefore the objective of the individual studies.

The EMRIA study method is a predictive procedure. Study reports provide answers to the "three basic questions", summaries of data gathered and analyses made, summaries of existing information utilized in the study and an explanation of how the conclusions were reached.

Formulation of study plans and supervision of studies is the responsibility of SO/DO. The Denver Service Center provides technical and administrative assistance and coordinates non-BLM inputs. Data collection, analysis,

report drafting, editing, printing, etc., is organized to make optimum use of other agency capabilities and private contractors. The normal sequence of actions in formulating study plans is:

1. Identify Study Area

Study area selection procedures are not included in this handbook. Suffice it to say, areas to be evaluated are identified by the State Director in accordance with his area ranking of reclamation information needs.

The study areas are to be located in areas that have potential for strip mining. Figure 1 shows the general location of strippable coal in the western United States. Other areas of interest to the EMRIA program are located in eastern Oklahoma and northern Alabama. Future studies may be extended to other states as need arises. Table 1 shows the extent of acres now under lease with development possible as national energy requirements increase. Those acreages listed under application and nominated may never be fully developed because of environmental-economic reasons.

Actual data collection sites or areas are delineated at the first study planning conference or during the early stages of the study. The configuration of the different types of data areas involved in the study will vary in accordance with the characteristics of the resource element under consideration. Thus, water data is collected by watersheds, soils data by taxonomic units, wildlife data by habitat areas, etc.

No limits are placed on size or configuration of study areas or data collection areas. The prime determinant is acquisition of the data needed to answer the "three basic questions". Other major considerations are data transferability and economy.

2. Determine Post-Mining Land Use Potentials to be Evaluated

The term reclamation is subject to a variety of interpretations and must be specifically defined for consistent understanding of site potential assessments. In the EMRIA program, reclamation is defined as, "the establishment of conditions suitable for the intended post-mining use". Use of this definition focuses attention on the primary land resource management considerations and permits narrowing the scope of studies thereby avoiding collection of data not actually needed for management decisions.

The land use and/or potential alternative uses the areas is to be evaluated for are specified by the District Manager at the outset of the study. Identified post-mining land uses are often the same as or only minor modifications of the pre-mining uses but in some cases may be entirely different with distinctly different site requirements.

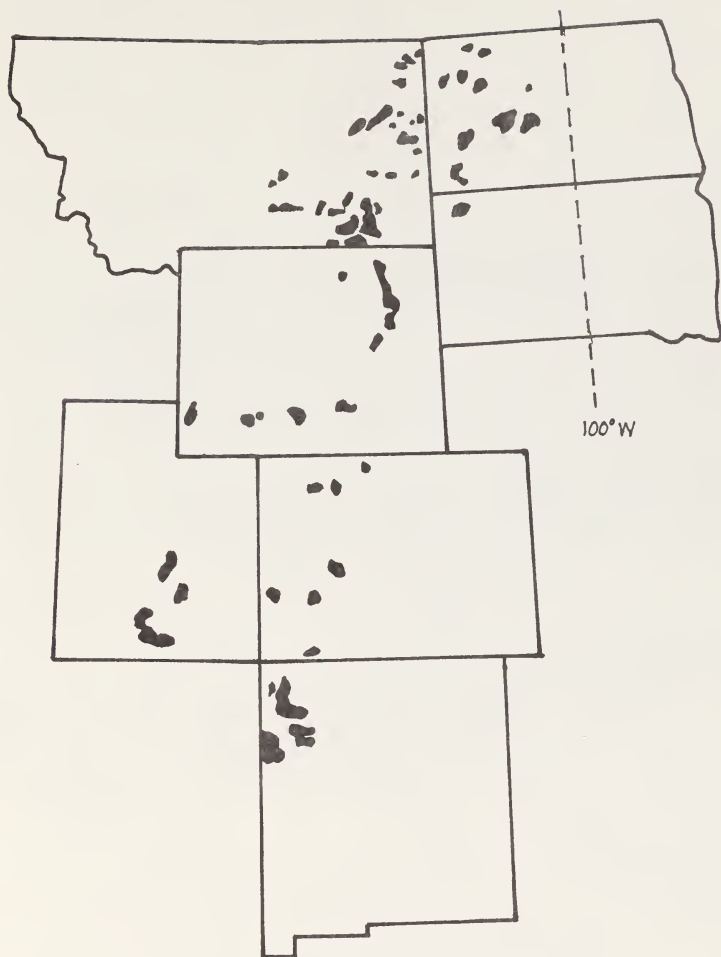


Figure 1.

• Generalized Location of
Strippable Reserves

TABLE 1

Acres of Federal Coal Under Lease, Application and Nominated
That the Bureau Administers Without Regard to Surface Ownership

State	Under Lease	Under Application ^{1/}	Nominated ^{1/}	Total ^{2/}
Alaska	27,000	13,000 15,500	-	15,700 15,500
Alabama	2,400	-	37,000 206,300	208,700
Colorado	215,200	94,100	482,700	792,000
Montana	73,400	26,300	1,027,500	1,127,200
New Mexico	41,000	77,600	301,200	419,800
North Dakota	15,500	-	431,000	446,500
Oklahoma	87,000	9,500	44,100	140,600
Utah	360,900	112,900	291,800	765,600
Wyoming	420,400	169,800	579,400	1,169,600
Other	7,900	-	14,900	22,800
TOTAL	1,223,700	505,700	3,378,900	5,108,300

^{1/} Total acres may never be developed.

^{2/} Approximate to nearest 100 acres.

*source?
what kind of apps
sum of apps + nominated may double count*

Land use determinations are based upon a complex of factors including physical characteristics, resource demands, statutes and regulatory restraints. These considerations are incorporated in the BLM planning system and are not part of the EMRIA program.

3. Determine Site Requirements for Intended Post-Mining Use

The characteristics that a site must possess to be acceptable for the intended use or that affect its usefulness in a significant way are identified and serve as specific targets for field investigations and analyses. Site requirements are worked out in consultation with the appropriate land use specialists, i.e., wildlife biologist/wildlife habitat, forester/woodlands, agronomist/farmland, engineer/industrial site, etc. Site requirements are documented in the report and specifically addressed in the analyses. Consideration of site stability, soil erosion and water quality effects on and off site, are included in all studies.

4. Determine What Information is Needed to Answer the "Three Basic Questions"

Information needs are derived from site requirements and are generally stated in terms of specific questions with quantifiable answers pertaining to site requirements.

5. Determine What Needed Information is Available

Availability of existing information is determined through review of existing inventory, planning, and impact study documents and consultation with agencies that have resource management or study programs in the area.

6. Define Study Parameters

Study parameters are defined to include only the data collection, analysis, and report writing necessary to provide answers to the "three basic questions" and explanations of how the conclusions were reached.

7. Conduct Study Planning Meeting

A study planning meeting is held by the State Directors' designated representatives prior to initiation of field investigations. The meeting is generally held in the District Office nearest the study area and participation by all organizations believed to have information and/or capabilities useful to the study is invited. Study area characteristics,

post-mining land uses, use requirement information needs and means of acquiring needed information are discussed. Study parameters are confirmed or modified, tasks identified and tentative assignments of responsibility for completion of each task are made.

Typically, the water studies and vegetation-soil-moisture relationships are conducted by GS-WRD, core drilling and analyses and report compilation and printing by BR, soil surveys by SCS, and wildlife habitat studies by F&WLS.

Other tasks are assigned on an ad-hoc basis to BLM personnel or other agencies or are designated for private contracts.

Individual study components or entire studies may be accomplished through contracts with private firms when lack of available manpower or necessary skills require it or when cost reductions can be realized.

8. Prepare Schedules and Work Plans

Work plans and schedules are prepared for each component and for the total in accordance with the availability of manpower and funds, i.e., in accord with participating agencies operating budgets and AWP's.

PART II - DATA GATHERING PROCEDURE

The data gathering procedures are those used and accepted by most scientists in their fields of interest. For example, the soil scientist uses those standards adapted by the National Cooperative Soil Survey. The water and vegetation investigators use those procedures developed by the Geological Survey, Water Resources Division. In the investigation and mapping of the overburden, the scientist uses methods developed by geologists. The criteria to evaluate the suitability of overburden for topsoil are those developed by USDA-ARS and the BR. The sediment yield studies use procedures developed for the PSIAC method.

Coal resources information is developed by the Geological Survey, Branch of Coal Resources. Data gathering procedures for the other parts of the physical profile not mentioned here are generally those developed by the BLM.

PART III - REPORT CONTENT, FORMAT AND DEVELOPMENT

The primary purpose of EMRIA study area reports is to provide information on reclamation potentials needed by management personnel to make coal lease site selections and to develop coal lease reclamation stipulations. Other purposes include documentation of baseline conditions from which change can be measured and providing detailed physical descriptions and resource inventories for use in a variety of management planning and impact evaluation activities.

Reports are directed to provide information primarily to the specialists. If the report is not readily understood by non-specialists, it is expected that the specialists will interpret the results.

Reports should not contain raw data (except as needed to explain conclusions), field notes, or canned statements of Departmental policy, project objectives or other unnecessary "boiler plate".

Report preparation begins with the initial study planning activities, when specific objectives are defined, and continues concurrently with the data acquisition and analysis activities. Development of the report is the responsibility of the contractor. Drafts of the individual study components are prepared by study participants in accordance with study task assignments. Collation of the draft, editing and preparation of final manuscript is a major task that will be assigned to the contractor. The review of the draft report is the responsibility of designated participants and EMRIA staff before publication.

CONTENT

The main elements of EMRIA study area reports are:

1. Study Purpose and Specific Objectives.

A short explanation of the purpose of the study in terms of acquiring information for lease site selections and stipulation development, and an explanation of the specific objectives in terms of answers to the "three basic questions" pertaining to the post-mining use alternatives.

2. Site Characteristics and Resource Values

A description of the study area including location, topography, climate, geology, soils, vegetation, water systems, wildlife habitat, other resource values and resource uses. Recreation, visual, historic, and archeological values should not be overlooked.

Each of the site characteristics should be described adequately to accomplish the purpose and specific objectives of the study without including unnecessary detail.

Descriptions of geology should contain sufficient detail on coal beds and overburden to assure an adequate factual basis for evaluation of reclamation potential. Similarly, water, soils and vegetation should be given close attention in all reports.

3. Study Methods

An explanation of the planning and execution of the study including problem definition, task assignments, investigators involved, secondary data utilized, new data acquired and analyses performed.

4. Conclusions

Answer the "three basic questions":

- A. Can the area be effectively reclaimed?
- B. What are the major problems involved in reclamation of the area?
- C. What reclamation measures are necessary to establish the desired post-mining conditions?

Answers are in terms of the identified post-mining use alternatives with an explanation of how the conclusions were reached.

The first question should be answered with a positive statement in terms of conditions suitable for post-mining use alternatives with qualifications in quantitative and/or qualitative terms as necessary.

The second question should be answered by identifying and explaining major problems or key factors involved in reclamation.

The third question should be answered by describing the measures assumed in answering the first question. Excavation, placement and shaping of spoil material and soils; surface stabilization including establishment of vegetation; reestablishment of surface and ground water systems and protection and management of the site should be included.

5. Bibliography, Data Sources and Report Availability

A bibliography of references used in the study, file references to data acquired and utilized in the study, and a list of EMRIA studies completed with notations on their availability should be included in the reports.

The following general guidelines should be followed in preparing EMRIA reports. They provide considerable latitude for variations in arrangement and style to suit the nature of the individual studies and the preferences of individual authors.

- A. Keep narratives concise. Omit unnecessary data.
- B. Use factual statements. Avoid unsupported conclusions, unnecessary discussions and opinions on what should be. (The study's purpose is to provide information - not to teach or persuade.)
- C. Place statements of purpose and objectives and at least a summary of conclusions up front.
- D. Use pictures, diagrams and tables whenever practical in presenting information.
- E. Put study name, date, location map and "EMRIA Report # _____" on front cover.

GUIDELINES
FOR
RECLAMATION STUDY AREAS
(ENERGY MINERALS REHABILITATION INVENTORY AND ANALYSIS)

RECOMMENDED
METHODS OF INVESTIGATION AND ANALYSIS

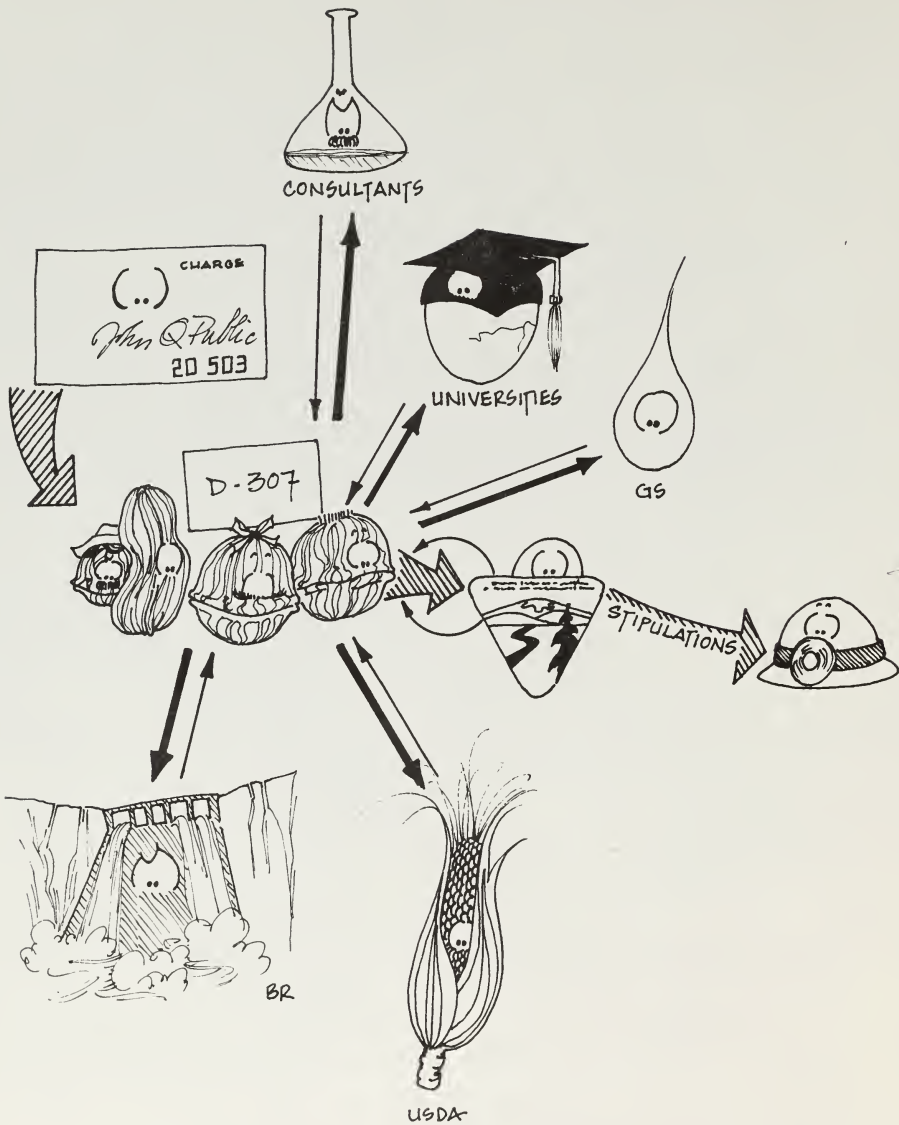
AND
REPORT OUTLINE

1977

UNITED STATES
DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

HERE'S HOW...





CLIMATE

DATA GATHERING

CLIMATE

The objective is to determine the climatic conditions on the study area. Climate is an important environmental factor determining the biological community and soil characteristics and soil behavior. The climatic parameters of most importance are precipitation, temperature, growing season, evapotranspiration, and storm characteristics (intensity, duration, and frequency). Other important climatic characteristics are wind, humidity and solar radiation. The climatic conditions on the reclamation study area, more than likely, will be different from that of the nearest U.S. Weather Bureau station. The investigator, by inference, shall estimate the climatic conditions on the study area; therefore, he should be able to predict hydrologic changes and the vegetation potential after disturbance under the identified climatic conditions.

The principal data source is the U.S. Weather Bureau Climatic Summary of the United States by state. Sometimes, other researchers have nearby stations that have useful data.

FIELD DATA

Observation and review of existing data.

Where microenvironmental data are lacking for a study area, field investigations are desirable.

CLIMATIC DATA REQUIRED

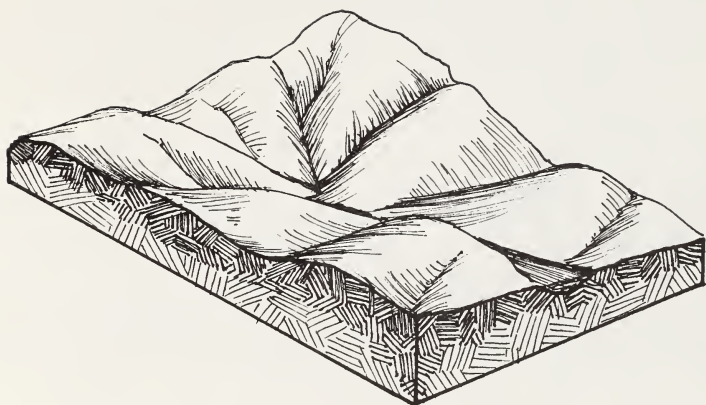
1. Table - Summary of a nearby Climatological Data Station, including mean monthly precipitation (in.), temperature ($^{\circ}\text{F}$) ($^{\circ}\text{C}$), and snow (in.).
2. Frost-free period or growing season at 32°F or 0°C .
3. Evapotranspiration - mean monthly values.
4. Storm characteristics - intensity, duration and frequency.
5. Other useful data:
 - A. Humidity
 - B. Wind (average direction and velocity)
 - C. Hail
 - D. Soil moisture
 - E. Soil temperature
 - F. Solar radiation

ASSUMPTION

Climatic data can be projected from nearby station(s) to the reclamation study area and an estimated climatic characteristic can be determined.

STATEMENT

Climate - A measurement of total soil moisture could be correlated with climatic parameters. This gives an indication of species to plant, time to plant, surface manipulations and least slope to grade spoil.



PHYSIOGRAPHY, RELIEF, & DRAINAGE

DATA GATHERING

PHYSIOGRAPHY, RELIEF AND DRAINAGE

The objective is to describe the physical land features and how they relate to mine land reclamation. The environmental characteristics of the study area are affected by the magnitude of the topography, landform and surface drainage patterns.

Aspect and topographic relief affects the microclimatic conditions from place to place. This microclimatic pattern affects the kinds of soils and associated plant communities. The rapidity of surface runoff and amount of bare soil affects the degree of erosion and amounts of sedimentation. Reclamation procedures are affected by elements of local relief and surface drainage.

FIELD DATA

Observation and review of existing data.

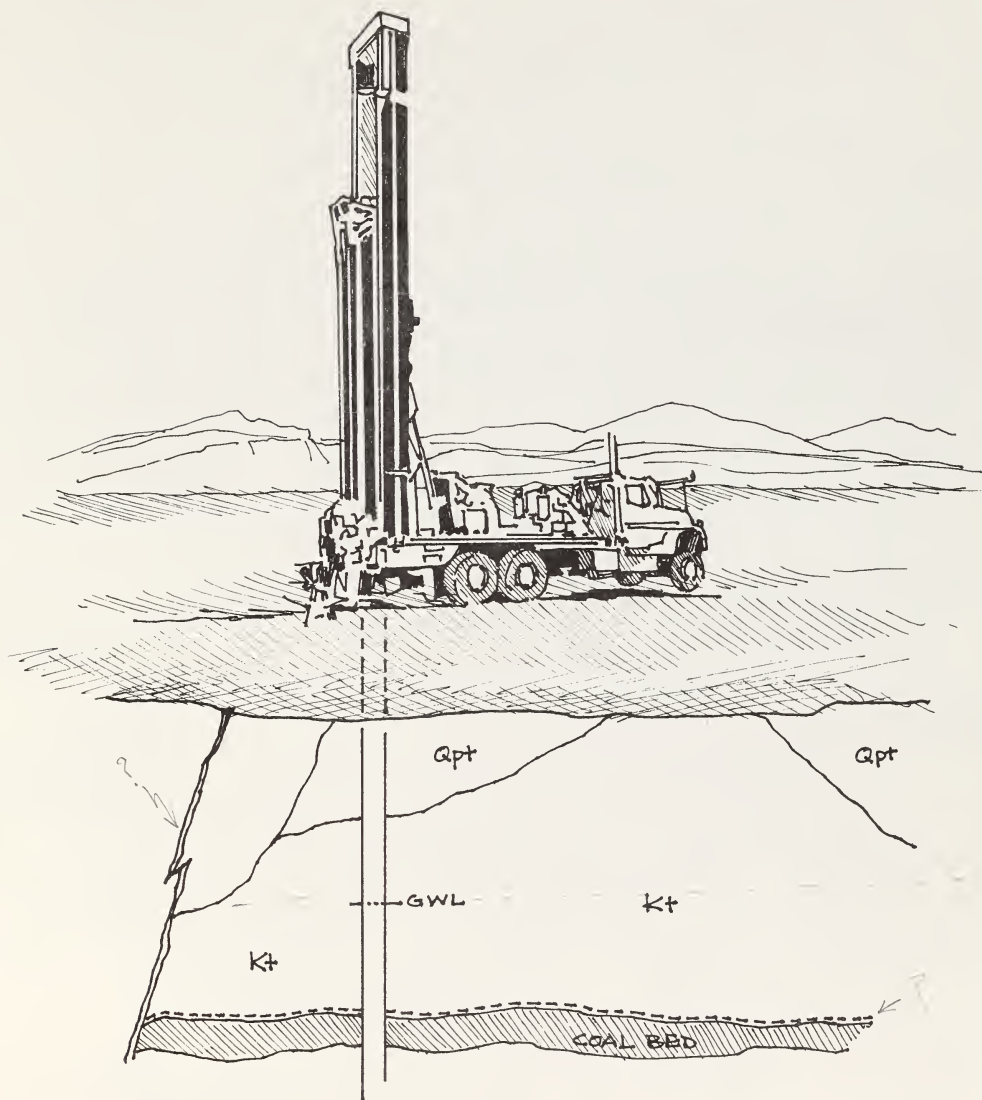
DATA REQUIRED

1. Physiographic province (N. M. Fenneman, 1928).
2. Physiographic section.
3. Physiographic subsection (E. H. Hammond, 1965).
4. Topographic features of the study area.
5. Elevation on the reclamation study area.
6. Slope and aspect on the reclamation study area.
7. Natural drainage systems (1st order, 2nd order, etc.) and the name of the streams associated with the reclamation study area.
8. Topographic map 7 1/2 minute quadrangle or equivalent to the reclamation study area.

STATEMENT

The geomorphic (Qualitative) features of drainages are of considerable interest in strip mined land reclamation. Drainage patterns develop in response to the interactions of climate, soils, geology and vegetation. Knowledge of surface drainage characteristics, therefore, are of considerable concern in reclamation when drainage patterns are reestablished.

GEOLOGY



DATA GATHERING

GEOLOGY

The objective is to accurately and efficiently collect geologic data to 1) identify, 2) map, 3) describe and 4) interpret in-situ characteristics for mined land reclamation. ✓

PRELIMINARY PROCEDURES

The geologic study shall be coordinated with the other related studies (soils, overburden, minerals (coal), ground and surface water, vegetation), so that geologic interpretations will not be duplicated. A literature review is necessary to determine the status of the present geologic information in the area of the reclamation study. It is necessary to determine the on-going or planned research by other agencies and institutions in the study area.

Determine through contacts the most useful map scale that is compatible with the other investigators of the reclamation study area. This is generally a map scale of 1:24,000 or larger.

FIELD PROCEDURES

Field investigations are required to collect original data to supplement and increase the accuracy of existing data. It is assumed that existing data is inadequate to some degree.

Field mapping shall be accomplished on either photographs or line maps of suitable scale for accuracy requirements. Neat and legible field notes shall be kept and the field description locations shall be located on the geologic map (see page 24). A copy of the field notes shall become the property of the BLM upon completion of the contract. Field notes are generally incorporated into the geologic map.

The data collection and its interpretations shall utilize those methods most commonly used by professional geologists, so that, another geologist may reasonably duplicate the results from field observations and other applicable data.

CORE DRILLING

Special emphasis shall be placed on the core drilling program for the reclamation study area. Drill holes shall be located to avoid unnecessary surface disturbance. The holes shall be located to obtain
↖ *wherever possible.*

the most information within the time frame and available resources for the project. The drill site selection shall be a coordinated effort between the contractor, GS, and the BLM based on an understanding of the geology or a statistical sampling technique. The drilling program shall be basically designed to provide overburden (geologic) data, not coal; even though an economic coal seam should be present or thought to be present. *Care the coal, too.*

Solid core drilling tools larger than standard exploratory sizes are preferred but are not necessary to 1) maximize core recovery, 2) provide sufficient sample for laboratory analysis, 3) minimize contamination potential and 4) allow placement of pipe in selected holes for monitoring ground water levels and ground water sampling.

The recovered geologic cores are placed in core boxes and covered. This is necessary for transport and to prevent loss of moisture and changes in the physical and chemical state. Coal cores should be immediately sealed in plastic bags to avoid deterioration. See Instruction #1, page 21, for drill hole abandonment.

The solid core is megascopically described. Representative samples are taken of the various rock types for laboratory analysis of the overburden and weathering tests. See Instruction #2, page 21, for disposition of core.

DATA REQUIREMENTS

Upon completion of the project, the contractor shall provide:

1. A written report summarizing the results of the geologic study.
 - A. The report will discuss significant factors of geomorphology, lithology (unconsolidated and consolidated rocks), structure, stratigraphy, paleontology, geologic hazards, geologic processes, hydrogeology, engineering geology, geochemistry, sedimentation.
 - B. A section will provide the land manager and lay reader with the significance of geologic conditions with respect to ground water, engineering geology, geologic hazards, beneficial and detrimental chemical elements in geologic formations with respect to animals and plants and areas of unique or unusual geologic features.
 - C. It shall provide an estimate of the reliability of data, conclusions, and interpretations so that the distance the data can be extrapolated may be determined.
2. Regional geology map.
3. Study area geology map. *note the #8.*
4. Potentiometric map, cross-sections, fence diagrams or other illustrations needed to illustrate specific conditions.
5. Geologic logs. *Sections.*
6. Well logs.
7. Location of drill holes on map.

NOTE:

The contractor will supply the USGS Geologic Division, Coal Resources Branch, geologic logs, geologic maps, geologic cross-section, overburden thickness map, and coal samples so that chapter on Coal Resources can be developed for the report. *plus coal isopachs*

INSTRUCTION #1. Drill Hole Abandonment

1. Methods used to abandon drill holes for conduct of the study, shall be in a manner to protect the surface and ~~not~~ to *protect* ~~endanger~~ any present or future underground operations or any deposit of oil, gas, other mineral substance *OK* of water strata.
2. Surveillance wells for the purpose of determining baseline conditions and subsequent effect upon the quantity, quality of ground water must be abandoned in the proper manner as designated by proper authority by the organization conducting the surveillance at the conclusion of the surveillance.

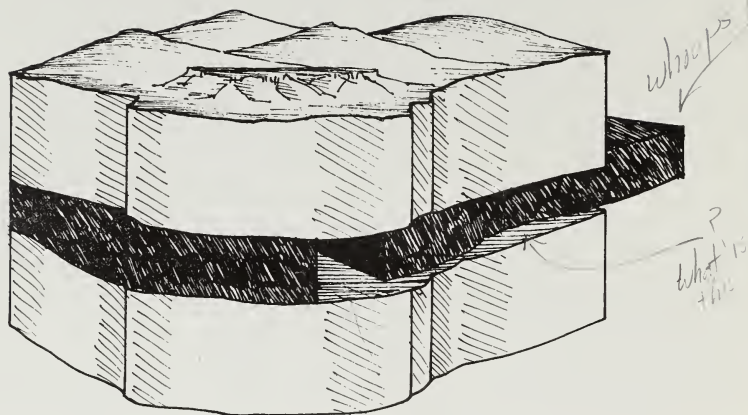
Item 1, drill holes not developed as ground water observation wells in accordance with appropriate governing laws and regulations should be plugged or backfilled in accordance with those laws and regulations.

INSTRUCTION #2. Disposition of Core

Disposition of core after sampling requirements shall be in the order of clearance.

1. USGS for the Regional Geochemical study team located at the Denver Federal Center.
2. State land grant university or equivalent.
3. State Geological Survey or equivalent.
4. Other interested agencies that will become known.
5. DO and SO geologist approval to discard; and
6. BLM's Rehabilitation Data Staff, D-307, DSC, approval to discard.

Natural or background gamma logs should be run in conjunction with an acoustic log and/or resistivity log for accurate detection and delineation of coal seams on all exploratory cored or drilled holes. It is preferable, where possible, to run self-potential, gamma gamma density, and caliper (hole diameter) logs in addition to the three above.



COAL RESOURCES

DATA GATHERING

COAL RESOURCES

The objective is 1) to locate, describe and evaluate the quality and quantity of strippable coal in the reclamation area and 2) to estimate the coal resources in the surrounding area whenever possible.

A description of the energy resource should include, as a minimum, based on solid core drilling, logging, sampling, analysis and geologic mapping, the depth, thickness, identification, classification and recoverability. *3rd 10/10/71*

FIELD PROCEDURES

The field investigations is that used for geology. The coal is logged, sampled and analyzed. The analytical procedures are those used by USGS. (Coal analysis will be furnished by the USGS - Coal Resources Branch).

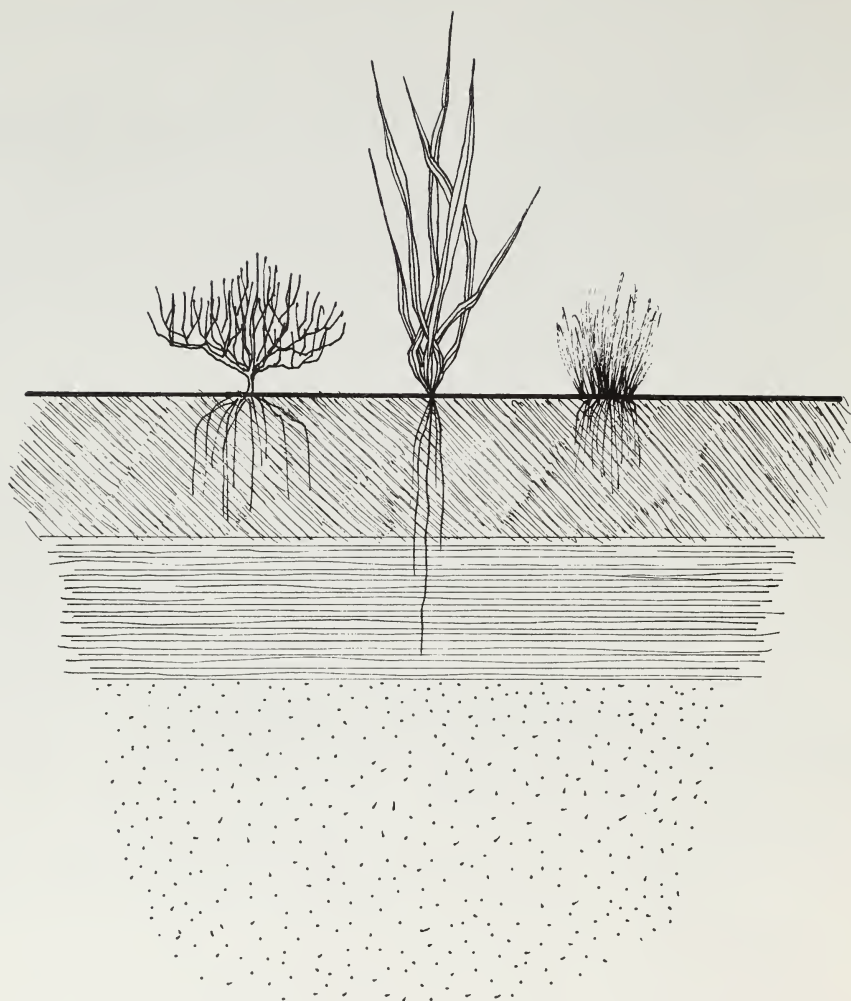
DATA REQUIRED

1. Geologic logs.
2. Prepare table - proximate, ultimate, Btu and forms of sulfur *and amount*
3. Classification of coal. *Meaning Rank?*
4. Tabulation of estimated coal resources of reclamation study area.
5. Estimate of identifiable coal resources of area (projection) around the reclamation study area. *by thickness, depth, mineral content, and reliability.*

STATEMENT

Coal resource characteristics need to be known before a lease can be issued and royalties determined (43 CFR Parts 3520 and 3040). *T- 10/10/71*

→ should be consistent with USGS Bulletins 1450-A and 1450-B.



SOIL & OVERBURDEN

DATA GATHERING

SOIL AND OVERBURDEN

The objective is to determine soil and overburden characteristics, both chemical and physical, which will be a basis for developing stipulations for the mined land reclamation part of the mine plan and for environmental protection. Soil and overburden characteristics will be identified for areal extent, thickness, physical and chemical characteristics for purpose of identifying potential or limiting factors associated with reclamation and management.

The field investigation shall be in two parts (soil and overburden) to satisfy the baseline data needed for the objective.

1. A. Soil inventory (survey) (SCS) 2nd or 3rd order (intensity).
B. Land unit capability (LUC) (BR) high or medium intensity.
2. Overburden identification (log) (??)

NOTE:

Item 1(B) above is only acceptable when accomplished by USDI-BR. All other investigators shall follow the methodology associated with item 1(A) above.

SOIL

FIELD PROCEDURES

The soil inventory (survey) shall be accomplished by utilizing aerial photographs with a scale of 1:24,000 or larger.

The location of the soil profiles shall be a systematic coverage of the area considering such significant soil and its associated plant communities, geologic and topographic features, as well as, any previous studies made by others in the area. The intent is to describe and sample representative soils independent of the underlying overburden. It would be coincidental if the soil and the representative underlying overburden coincide at the exact same location.

Soil profiles shall be exposed through the solum plus "one-foot" into the underlying overburden (C-horizon) for all soils series on the study area and described. The nomenclature of the soil descriptions shall be consistent with the standards in the Soil Survey Manual, USDA-Handbook No. 18. (The intent is to expose, describe and sample the soil and underlying soil material to a depth of about 10 feet dependent upon the hardness of the bedrock.)

Soil sampling shall be accomplished on all major and significant minor soil series or soil units represented on the study area. The soils that are sampled shall be representative of the phase of series for the soil mapping unit and are typical for their chemical and physical characteristics.

Soil samples shall be taken from the principal genetic horizons plus those in the overburden. These are bagged, tagged and recorded. The samples shall be analyzed by approved techniques in a laboratory agreeable to the contractor and the BLM.

An initial or progress and final field review (soil) by the contractor, in conjunction with the Bureau of Land Management representative (COAR), shall be mandatory to insure consistence and uniformity in standards for soil mapping, soil classification and soil interpretations. If the investigator is other than SCS, then a soil scientist from SCS shall be invited to participate in all field reviews.

DATA REQUIRED

There are two systems of field investigations to determine soil or land suitability for topdressing that are acceptable to the BLM. These are those used by 1) USDA-SCS and 2) USDI-BR.

1. If field and laboratory procedures are those used by SCS, then data requirements are: (See Note 1, page 28).
 - A. Prepare map - soil inventory (survey) (phase of series). (See Note 2, page 28).
 - B. Prepare map - topsoil suitability. (See Guidesheet #1, page 32).
 - C. Prepare table showing acreage and average depth of suitable topsoil. (See Illustration 1, page 33).
 - D. Prepare a land capability map using USDA-SCS guidelines.
 - E. Prepare table - soil chemical data.
 - F. Prepare table - soil physical data.
 - G. Prepare soil profile descriptions.
 - H. Prepare soil mapping unit descriptions.
 - I. Prepare table - soil inventory (survey) interpretations. (See Note 2, page 28).
 - J. Prepare table - soil classification.
 - K. Prepare map - showing prime and unique farmlands and alluvial valley floodplains.
2. Alternative, to be used by USDI-BR only. Field and laboratory procedures are:
 - A. Prepare map - land suitability classes.
 - B. Prepare map - depth and suitability of surface material.
 - C. Prepare table - chemical and physical data (BR Form 7-2006B).
 - D. Prepare map - showing prime and unique farmlands and alluvial valley floodplains.

STATEMENT

1. Soil inventory (survey) criteria used by SCS is the most commonly accepted methodology to meet the needs of the BLM and other users of soil information. The inventory is made to collect soil resource information that is useful in developing land use plans, recommendations involving soil management systems and evaluating and predicting effects of continuing and changing land uses. The standards are those of the National Cooperative Soil Survey and the soils are classified according to Soil Taxonomy, AH 436.
2. Laboratory procedures are those most commonly used by USDA-SCS and ARS and by USDI-BR and GS. A laboratory plan shall be developed by BLM for the investigator to meet the requirements of the BLM and include those requirements by state rules and regulations when applicable. BLM requirements are those needed for standard soil characterization data, this is basic; then, add those requirements needed by state rules and regulations. For example: Wyoming DEQ requires selenium (if indicator plants are present) that is in addition to BLM requirements; Montana Department of State Lands, Reclamation Division, requirements for soil beyond those required by BLM is the trace element boron. Montana also requires trace elements in the overburden beyond what BLM requires. These are boron, cadmium, copper, iron, lead, manganese, mercury, selenium, molybdenum, zinc, nickel, nitrate and ammonium.
3.
 - A. Topsoil suitability as now defined by SCS may be too restrictive in the interpretation of overburden material for topdressing of strip mined spoils. (See Guidesheet, page 32).
 - B. Topsoil suitability criteria developed by BR-regions for overburden may be better suited for the needs of the BLM for topdressing of strip mined spoil. It includes an interpretation for the entire geologic profile (log) excluding the coal beds.
 - C. Topsoil suitability minimal requirements are as follows; pH, EC, SAR and selected trace elements as required by state rules and regulations.

Needs a sheet to explain the abbreviations

NOTE 1:

- A. Existing USDA-SCS soil surveys may satisfy BLM soil inventory requirements dependent upon age and quality of the survey. This includes legends, mapping unit descriptions, interpretations, and taxonomic classifications. The BLM, as a member of the National Cooperative Soil Survey, is obligated to enter the qualified soil information into the National Soil Survey bank.
 - (1) A 2nd order soil survey will satisfy the requirements for Reclamation Study Area if supported by soil chemical and physical data.
 - (2) Some 3rd order soil surveys will satisfy the requirements if phases of series and some families are mapped on 1:24,000 scale and is supported by soil chemical and physical data.
 - (3) Generally, soil chemical and physical data will be lacking regardless of the intensity of the existing SCS soil survey and this is required.
- B. Reference to format or style commonly used by those agencies.

NOTE 2:

All Reclamation Study Areas require on-site chemical and physical data.

NOTE 3:

Computer generated table for SCS-Soils 5 can be readily obtained through the SCS for correlated soil series. See National Soils Handbook, Part II, Section 602.

OVERBURDEN

The overburden, less the soils, investigation shall be accomplished by solid core drilling and sampling contrasting strata. The drill sites shall be selected for a systematic coverage of the study area. Some modification is expected and shall be agreeable to the BLM.

The solid core drilling procedures and techniques are those stated in Geology; also, see Instruction 1, page 30.

The location of each drill hole shall be shown on a map.

Coal samples are taken by USGS, Coal Resources Division, and the analysis is performed by USGS and BM. The data is reported under heading, "Coal Resources".

Selected samples from the solid core are taken for 1) chemical and physical data, 2) greenhouse studies, 3) weathering tests and 4) for identification and quantity trace elements. The USGS, Branch of Regional Geochemistry, has requested overburden samples for their project on trace elements that affect plants, animals and human health. The BLM directs the investigator to supply these samples to the GS whenever possible.

Size of Soil and Overburden Sample:

- | | |
|------------------------|------------------|
| 1. Greenhouse studies | about 2,000 gms. |
| 2. Weathering tests | about 300 gms. |
| 3. Trace elements | about 100 gms. |
| 4. Overburden analysis | about 2,000 gms. |

DATA REQUIRED

1. Prepare table - overburden chemical data.
2. Prepare table - overburden physical data.
3. Prepare figure - overburden suitability as a plant growth medium in mined land reclamation.
4. Prepare figure - overburden thickness.
5. Presence of water supply (surface and/or ground). (Possible source for vegetation.)
6. Greenhouse studies for germination and vegetative growth.
7. Weathering studies for breakdown to allow for their possible use as a planting media in revegetation and stability of slope.

STATEMENT

Mapping the extent of each individual strata in the geologic formation is not practical under the anticipated drilling density. The objective is to broadly identify and characterize the overburden and trace elements that affect man, plants and animals.

INSTRUCTION #1:

In areas where surface mining is anticipated, the investigator shall drill a sufficient number of solid core holes for sampling to cover the geology of the study area. The holes shall be drilled through the last surface mineable coal seam and into the stratum (3 to 20 meters) immediately below the coal. The core shall be logged, sampled, and analyzed for its chemical and physical characteristics.

SCREENING TESTS (to be used by USDI-BR only)

A screenable laboratory program should be followed to characterize soil and other overburden material. The first priority in laboratory characterization should be accomplished by direct and indirect measurements for evaluating soil structure and its stability, soil-cation-exchange capacity or surface area, soil reaction, and soil salinity. After this is accomplished, then consideration should be given to testing that confirms, explains the causes of phenomena previously observed or predicted, reveals the present of toxic elements (salinity level, boron content, alkali, acidity, reduction products, etc.), and indicates what and how much is required to cope with the soil deficiency under eventual field conditions and the moisture regimen expected to prevail.

It is essential that soil, as well as core samples, be put through a screenable laboratory testing procedure that generally includes disturbed hydraulic conductivity, pH, settling volume, EC and 15-bar water. These screening tests lead to further laboratory analysis to identify specific problems as to the suitability of that overburden strata as a plant growth media.

Overburden samples (soil and underlying geologic materials) are taken for laboratory analysis. Sample each contrasting layer or 5 feet of same strata.

A surface soil (A-1 horizon or equivalent) should be taken from the Reclamation Study Area that represents the standard soil for the area. This is to be used in the greenhouse studies. One sample duplicated (total 2 Kgms or more).

Screening tests and other analyses to be used by other contractors: all overburden samples that show a pH greater than 7.5 and an electrical conductivity (EC) greater than 4 mmhos/cm shall have the following chemical analyses completed on the saturation extract:

1. Saturation percent.
2. Sodium (meq per liter).
3. Calcium (meq per liter).
4. Magnesium (meq per liter).
5. Sodium adsorption ratio (SAR).
6. Gypsum (meq per 100 grams).
7. Boron

All overburden samples shall have a textural analysis on the fines that are less than 2 mm in size.

When overburden is the only topdressing (plating) available for mined land reclamation, it has been noted by some investigators that the overburden material (spoil) must have at least 30% by volume fines (less than 2 mm in size) to adequately support and maintain satisfactory vegetative cover.

Other chemical and physical data may be needed to satisfy requirements imposed by current state or local law, ordinances, rules or regulations.

GREENHOUSE STUDIES

The objective is to evaluate the suitability of overburden as a plant growth media for reclamation of drastically disturbed lands.

This test is useful primarily as a gross screening test for indications of unsuitable plant growth media. Other laboratory methods are needed to detect causative factors.

Recommendation for further laboratory studies is required. (Example: trace element studies as required by state or Federal rules and regulations).

WEATHERING

Selected samples from the solid core should be analyzed for possible physical and chemical changes upon exposure to weathering.

Laboratory procedures are those developed by the Materials Sciences Section, Research Division, E&R Center, Denver Federal Center, Denver, Colorado, 80225; or

Laboratory procedures are to be developed and interpretations made that are applicable to strip mined land reclamation.

GUIDE SHEET 1

SUITABILITY RATINGS OF SOIL (TO DEPTH OF 1 METER)
FOR USE AS A PLANT GROWTH MEDIUM
IN DRASTICALLY DISTURBED LAND RECLAMATION

DOMINANT LAYERS IN UPPER METER OF SOIL
(WHEN APPLIED TO PHASE OF SOIL SERIES)

FACTORS AFFECTING USE	DEGREE OF SUITABILITY		
	GOOD	FAIR	POOR (Essentially unsuitable)
EC (mmhos/cm)	<8	8-16	>16
SAR	<2	2-12	>12
ESP ^{1/}	<2	2-15	>15
pH	5.0 - 8.5	3.5 - 5.0	<3.5; >8.5
Coarse Fragments over 3 inch diameter (percent by volume)	<15	15-35	>35
Intermediate Textural Group	medium moderately fine moderately coarse	fine	coarse
Available Water Capacity (inches/inch)	>.1	.1 - .05	<0.5
Depth to Bedrock or cemented pan	>40"	20 - 40"	<20"
Slope (%)	<8	8-15	>15

^{1/} Rate 2:1 Clay texture poor if over 10; Sand texture if over 20.

For other overburden, disregard slope and depth to bedrock and add consideration for sulphides and toxic materials.

When rating overburden, EC, SAR, pH and texture are used from the table.

ILLUSTRATION #1

Map Symbol _____ and/or Soil Name _____

Physical and Chemical Properties by Layer/Horizons

Layer	Thickness (Inches)	USDA Texture or Textural Group	Salinity mmho/cm	SAR	ESP	pH	Stoniness	Coarse Fragments	Bulk Density	Slope (%)	Moist Consistency	Rating Class	Remarks

Estimated Volume of Soil Material by Suitability Rating Class

Rating	Acres	Inches	Total Acre Feet	Remarks



VEGETATION

DATA GATHERING

VEGETATION

The objective is to identify, classify and determine present plant cover, to determine the potential soil-plant community, and to estimate potential vegetation yield; (1) to define the hydrologic characteristics of soils associated with existing soil-plant community, and (2) to estimate the soil material - vegetation relationship or characteristic during and following reclamation of mined lands.

DATA REQUIRED

1. Prepare table - percent of vegetation, mulch, rock and bare soil at the sample sites. Determine plant composition on dry weight basis by species.
2. Prepare map - soil-plant community.
3. Prepare list - existing native plant species and their frequency and cover that could be used in mined land reclamation.
4. Estimate potential plant community and yield by soil units.
5. Determine if threatened and endangered plant species are present.
6. Take photographs of each vegetation community.
7. Prepare present production values or rating by plant community.
8. Prepare estimated potential production values or ratings by plant community, AUM's.

(Reference: National Range Handbook, USDA-SCS, July 13, 1976)



SEDIMENT

DATA GATHERING

SEDIMENT

The principle objectives of activities related to sediment are:

1. To determine upland source areas of sediment;
2. To estimate the erodibility of surficial materials;
3. To produce regional maps of upland sediment yield in the existing environment and land-use patterns;
4. To predict potential changes in sediment yield caused by land disturbance; and
5. To establish a monitoring network to evaluate the effectiveness of reclamation practices.

The implementation of these objectives can be accomplished by three types of investigations:

1. Reconnaissance studies that will gather available information on a region and assist in focusing attention on areas that may present special problems in mining or reclamation.
2. On-site studies that will furnish the detailed information for establishing lease stipulations and monitoring of mining and reclamation activities.
3. Studies of surface water, ground water, and quality of water, including sediment discharge, on unreclaimed spoils and on reclaimed mine areas.

FIELD PROCEDURES

Determination of upland source areas of sediment can be estimated quantitatively by a combination of two methods:

1. Sediment accumulation in small stock reservoirs is measured and a rate of sediment yield is derived from historical data on the age and operation reservoir.
2. A qualitative assessment is made of drainage basin characteristics, both physical and biotic, using the method described by the Pacific Southwest Interagency Committee (PSIAC, 1968). The PSIAC method has produced good correlations of basin characteristics and sediment yield for basins from 0.1 to 50 square miles. The combination of reservoir sedimentation data and the PSIAC method will allow regional estimates of sediment yield under existing land-use patterns.

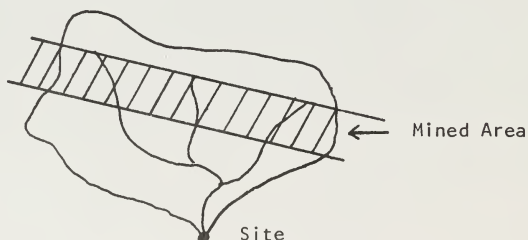
These kinds of information will permit establishment of lease stipulations regarding allowable sediment yield from the mined area during mining and reclamation. Also, reclamation can be regarded as successful when sediment yield returns to rates comparable to or less than pre-mining conditions. Where small reservoirs are not available to obtain data on sediment yield in the existing environment, the Geological Surveys' rainfall simulator can be used to establish hydrologic characteristics of upland soil-plant communities.

In conjunction with studies of areas and regions that have a high potential for leasing in the near future, detailed studies should be made in representative nearby areas already mined and in the process of being reclaimed by various methods. Data on these areas may be gathered and evaluated using the small reservoir method of measuring streamflow and sediment yield, the rainfall simulator, and standard gaging station records. In addition, the soil loss from disturbed areas can also be estimated by using methods developed with the Universal Soil Loss Equation (Wischmeier, Johnson, and Cross, 1971).

During the period prior to leasing and continuing through the period of several years of mining and reclamation before the land is considered returned to a post-mining land-use plan, small watersheds that are not disturbed should be established and monitored as control basins furnish the information necessary to verify and evaluate the success of reclamation.

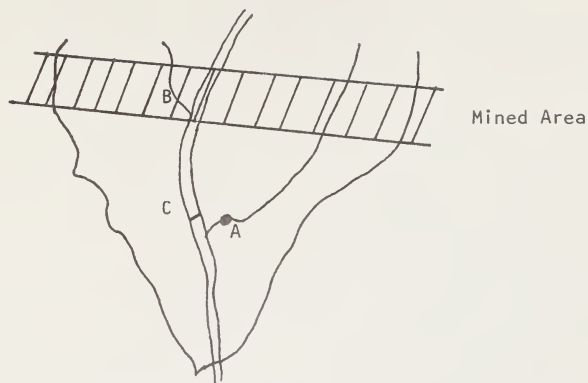
DATA REQUIRED

1. Purpose: To determine variations in concentration and load with time (instantaneous, daily, monthly, seasonally, yearly) and with discharge (cfs, acre-feet per square mile, inches of runoff).
2. Type (natural) - Indicator
 - A. Watershed representative of general area.
 - B. Size of watershed to be determined as representative of size to be mined.
 - C. Watershed not to be disturbed in any manner (mining, road building, disposal area).
 - D. Started as soon as possible, to continue until reclamation or rehabilitation of area is considered finished by authorized officer in consultation with the mining supervisor and the surface owner. (43 CFR 3040 and 211.40 (13) (ii)).
3. Mined (actual)
 - A. Small watershed (.01 to 10 square mile).



Standard procedures to determine sediment concentration and load from watershed upstream.

B. Crossing large water course.



- (1) Site A as above.
 - (2) Site B, reconstruct channel and floodplain of large water course to same geometry as pre-mining with same material. Reconstruct small drainage channel to equal or better flow characteristics as original.
 - (3) Site C, monitor concentrations and loads until rehabilitation of area is considered finished by BLM.
4. Water passing monitoring site must meet specifications as outlined by state law. (State specifications in Part II, Appendices, Sediment).
- A. Sediment retention reservoir immediately downstream of mining activity.
- (1) Drop outlet structure allowing water to pass through, and a pond allowing sediment, time to deposit. Structure must have sufficient capacity to hold most flows and allow large flows to by-pass (emergency spillway). Structure must be maintained during its life (clear material plugging drop structure. Repair spillway.) If filled, construct new structure. At end of rehabilitation period, construct by-pass channel around sediment filled pond. Vegetate sediment pond. Protect by-pass channel with rip-rap or natural vegetation.
5. Rehabilitation - Fluid leaving area must meet state requirements and be as close to natural conditions as practicable.



HYDROLOGY & WATER SUPPLY

DATA GATHERING

HYDROLOGY AND WATER SUPPLY

The objective is to provide water resource information to the BLM decision maker for evaluating potential impacts on a given land unit that includes the reclamation study area by various management alternatives.

METHODS

1. Study small basins^{1/} in an effort to understand basic surface and groundwater processes.
2. Develop a basic data network to permit transfer of information from small basin studies to areas without data.
3. Develop some predictive tools that can be used to assess potential impacts from surface mining or modify those in existence.
4. Identify pertinent relationships between water quality and flow and relationships between specific water quality parameters.
5. Identify standards against which to measure changes.
6. Develop reconnaissance techniques to identify potential problem and data needs.

NOTE:

Each study is unique depending on precipitation zone, vegetation type, physiography and hydrologic regime. In addition, water quality is studied. Water quality parameters are selected based on knowledge of the area. Some areas require a total suite of parameters (inorganics, organics, trace elements, heavy metals, radio-chemical and physical). Other areas may require a more intensive look at a specific problem such as sedimentation.

Ground water studies determine direction of flow, potentiometric surface, well yields, water quality and possible effects on the aquifer from surface mining.

FIELD PROCEDURES

Standard US Geological Survey procedures are used in the surface and ground water investigation associated with a reclamation study area. Generally, it will be desirable to investigate the larger watershed in

^{1/} The small basin studies attempt to look at the hydrologic process and quantify the elements: $RO = P - ET - L$ where:
RO = runoff; P = precipitation; ET = evapotranspiration;
L = losses such as interception, infiltration, deep seepage, etc.

which the study area is located rather than the small reclamation study area to answer initial questions concerning leasing stipulations. More site specific studies may follow depending on specific requirements.

After the area has been selected by BLM, USGS-WRD scientists will visit the area to determine what instrumentation is needed to meet the objective. Water quality parameters and sampling frequency will be selected based on existing data and previous knowledge of the area. Water quality analysis will be by standard USGS central laboratory procedures.

DATA REQUIRED

1. Prepare map of locations of surface-water quantity and quality stations, precipitation gages, climate stations, and observation wells.
2. Continuous measures of streamflow, water temperature, and specific conductance which are reduced to daily, monthly, and annual values.
3. Monthly surface-water quality samples for monitoring major chemical constituents. Quarterly water samples for monitoring trace metals, organics, and any materials posing potential problems.
4. Annual or semiannual ground water quality samples for monitoring major chemical constituents, trace metals, organics, and any materials posing potential problems.
5. Quarterly to annual ground water level measurements for determining potentiometric surface of major aquifers and directions of ground water flow.
6. Aquifer properties which can be computed from pump tests on available observation wells.
7. Identify surface or ground water sources suitable for reclamation irrigation needs where applicable.

WILDLIFE



DATA GATHERING

WILDLIFE

The objective is 1) to determine the present and potential wildlife use and 2) the probable effects on wildlife both on and off-site effects during and after surface mining.

Field procedures and interpretations - BLM Manual 6602 - "Wildlife Habitat Management System" contains procedures and methodology.

DATA REQUIRED

1. Prepare map - plant community (present; prepare map - crucial areas and record relative numbers by species; prepare map - migration route and direction by species affected).
2. Identify plant species present composition, frequency and pattern.
3. Identify the potential plant community based on phases of soil series).
4. Identify threatened and endangered species (flora and fauna) (Federal and State) (critical areas).
5. Species of wildlife present:
 - A. Plant community.
 - B. Season of use on plant community (numbers - present and potential).
 - C. Key habitat, (winter range, strutting grounds, etc.), (animal numbers present).
 - D. Migration routes.
6. Potential wildlife species.
7. Present land use.
8. Post-mining land use.
9. Identify special data needs.



CULTURAL RESOURCES

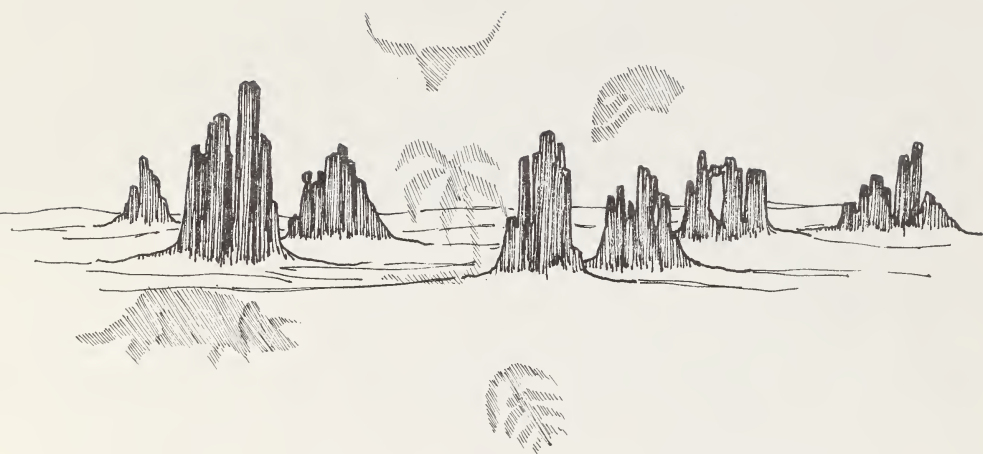
DATA GATHERING

CULTURAL RESOURCE

The objective is to locate and identify cultural resources, any present features that have historic or archeologic value. The archeologist shall identify specific deposits that would be likely to contain stratified prehistoric information (in context) relating to the past 30,000 years.

A statement is necessary to show that the archeologist and historian have investigated the proposed reclamation study area and have declared the area either lacking or having historical cultural features that warrant further investigation or preservation. The investigator must be aware of valued cultural sites, trails, structures, etc., and recommend measures to avoid damage to the resource.

FIELD PROCEDURES AND INTERPRETATIONS (BLM Manual 6100 and 6200)



PALEONTOLOGY

DATA GATHERING

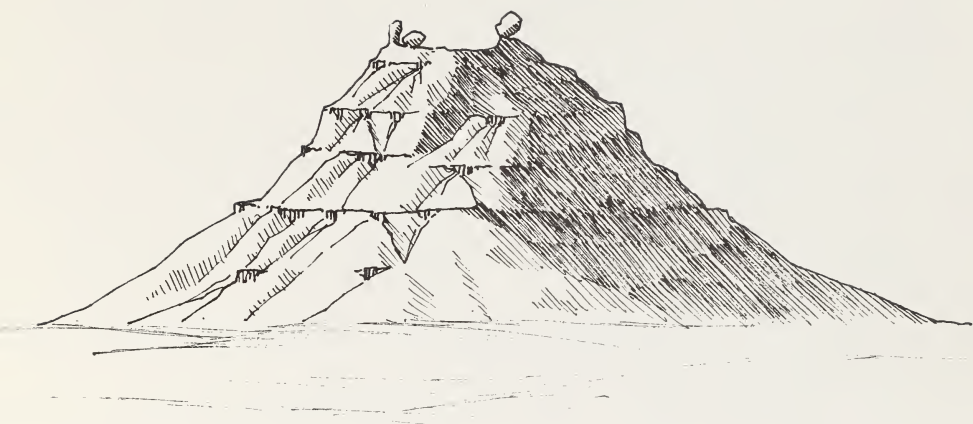
PALEONTOLOGY

The objective is to determine the presence of important landforms and geological fossil materials (microfossils, macrofossils, floral and faunal) which would have scientific value and are associated with identified geological formations in the reclamation study area.

A statement shall be made declaring the reclamation study area free of such important considerations or requiring further investigation of a certain nature. The investigator must be aware of valued fossil or landform and recommend measures to avoid damage to the resource. State paleontologist should be consulted to determine what significant paleontological resources are present in the study area.

may not be available

FIELD PROCEDURES AND INTERPRETATIONS (BLM Manual 6100 and 6200)



VISUAL RESOURCES

DATA GATHERING

VISUAL RESOURCES

The objective is to identify, evaluate and manage visual resource values; to minimize the adverse impacts on public lands while at the same time maintaining the effectiveness of those practices; to provide a means for identifying and analyzing visual resource values for inclusion into Unit Resource Analysis and Management Framework Planning.

Strip-mining activities involve alteration of the natural character of the landscape. Because these alterations will change the landscape character, it is imperative that they be understood and treated in a manner that reinforces the natural character and quality of the landscape. It must be recognized that there is a variety of scenic values on public lands and there are numerous other resources with management objectives that may not coincide with the protection of the visual resource. These different values and objectives warrant different levels of protection for the visual resource. Because of the different levels of visual sensitivity of the landscape and scenery quality variation, it is necessary to have a system to evaluate the visual resources and to determine what degree of management is desirable and practical, including protection, rehabilitation and enhancement.

The system is divided into three major components:

1. 6310 - Visual Resource Inventory and Evaluation. An inventory and evaluation process which provides minimum visual resource management class for all public lands as input to the BLM planning system.
2. 6320 - Visual Resource Contrast Rating. A visual contrast rating system will meet the visual resource management class that has been established for the area.
3. 6330 - Visual Resource Project Planning and Design. Methods and concepts for reducing the visual impact of management practices and projects in an effort to meet the visual resource management class without substantially reducing the effectiveness of productivity.

DATA REQUIRED

1. Scenery quality inventory.
2. Visual sensitivity analysis.
3. Visual zone determination.
4. Visual resource management class.
5. Planned used after mining (MFP).

A map of the United States showing the distribution of the Great Plains region. The states shaded with diagonal lines are Montana, Wyoming, Colorado, Nebraska, Kansas, Oklahoma, Texas, North Dakota, South Dakota, and Minnesota. The rest of the United States is unshaded.

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NOTE: The text of the report manuscript should adequately describe the data collected and its analysis. The authors should use tables, figures, photos and plates as needed in the text to clarify conclusions. All other illustrations, descriptions and definitions should be placed in the Appendices under the discipline described as back-up material for the conclusions made.

RECLAMATION STUDY AREAS

EMRIA

EMRIA Report Number,
Year, Name and Date

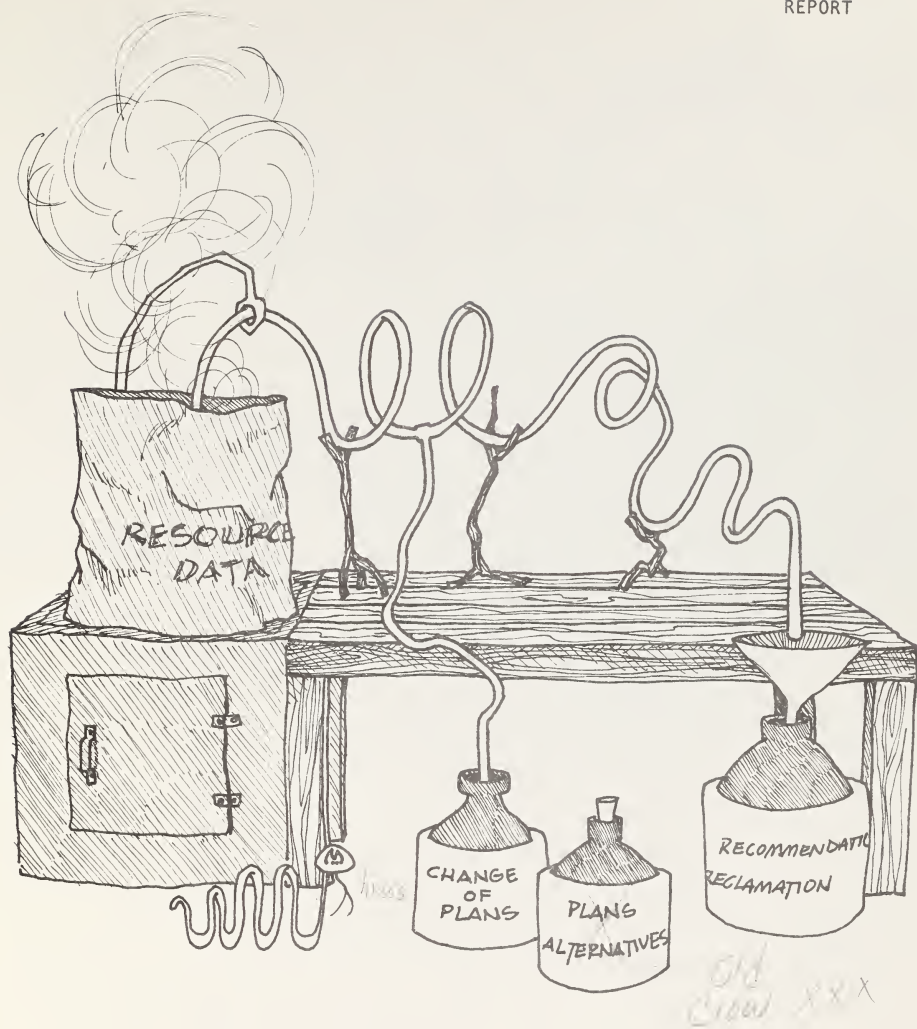
1-75	Otter Creek, Montana
2-75	Hanna Basin, Wyoming
3-75	Taylor Creek, Colorado
4-75	Alton, Utah
5-76	Bisti West, New Mexico
6-76	Foidel Creek, Colorado
7-76	Red Rim, Wyoming
8-76	Bear Creek, Montana
9-76	Horse Nose Butte, North Dakota
10-77	Beulah Trench, North Dakota
11-77	Pumpkin Creek, Montana
12-77	Hanging Woman, Montana
13-77	White Tail Butte, Wyoming
14-77	Potter Mountain, Wyoming
15-77	Henry Mountain, Wyoming
16-77	Emery, Utah
17-77	Kimbeto, New Mexico
18-77	Fish Creek, Colorado
19-78	Ojo Encino, New Mexico
20-78	Lay Creek, Colorado
21-78	Prairie Dog Creek, Montana
22-78	Rattlesnake Butte, North Dakota

OTHER EMRIA STUDIES

- | | | |
|-------|----------|--|
| 23-76 | USDI-BLM | Characterization Studies of Major Soils Found in Proposed Oil Shale and Coal Development Areas of Northwest Colorado. Colorado State University. 1976. |
| 24-76 | USDA-FS | Evaluation of the Vermeer Model TS-44A Tree Spade for Transplanting Trees on Surface Mined Land. 1976. |
| 25-75 | USDA-ARS | Effect of Method of Sampling Overburden on Results of Laboratory Analysis. J. F. Power and F. M. Sandoval. 1975. |

COOPERATIVE STUDIES

- | | |
|----------|--|
| USDA-ARS | Recommended Methods of Analysis for Mined-Land Spoils and Overburden. F. M. Sandoval and J. F. Powers. 1975. |
| USDA-FS | Handbook Equipment for Reclaiming Strip Mined Land. 1977. |



SUMMARY

SUMMARY

The object is to present the lay reader with a brief, concise, nontechnical description of the results, conclusions and recommendations for mined-land reclamation of the reclamation study area.

The items to be covered are location and setting and historical development. The results of the physical profile are discussed along with the effects and recommendations for mined-land reclamation without regard to socio-economic problems.

INTRODUCTION

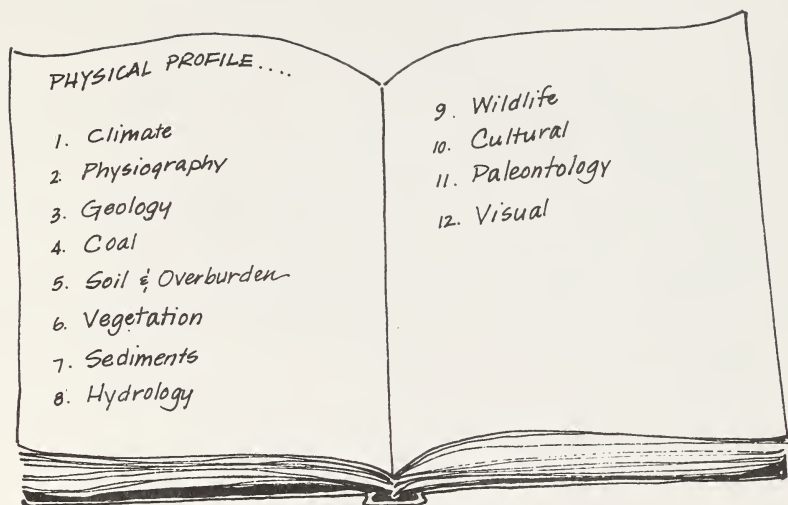


INTRODUCTION

The introduction shall include the following items:

1. Purpose and objective.
2. Authority.
3. Responsibility by BLM and contractor.
4. Location maps, regional and reclamation study area.
5. Historical development.
6. Future development, if applicable.
7. Land status map.
8. Mineral status map.

The BLM shall furnish this information for the report unless otherwise indicated. This information is to be placed into the body of the report.



PHYSICAL PROFILE

PHYSICAL PROFILE

1. CLIMATE

- A. Location, elevation and length of record of station(s) from which the investigator projected to the study area.
- B. Temperature
 - (1) monthly average
 - (2) growing season based on daily minimum temperatures at 28°F and 32°F
 - (3) include highs and lows
- C. Precipitation.
 - (1) monthly average
 - (2) seasonal variation - mean annual and long-term average
 - (3) rain and snow relationship, snow accumulation and persistence
 - (4) include highs and lows
- D. Evapotranspiration demand.
- E. Other climatic characteristics - wind, humidity, hail, frost action, etc., that affect reclamation.
- F. Storm characteristics - intensity, duration and frequency.
- G. Relate climatic conditions that affect reclamation and to make recommendations for spoil orientation and the handling of topsoil materials to enhance micro climatic factors for optimum reclamation success.
- H. Literature cited.
- I. Summary.

2. PHYSIOGRAPHY, RELIEF AND DRAINAGE

- A. General description of the regional physiographic province.
- B. Detailed description of the physiographic features and surface drainage of the reclamation study area.
 - (1) elevation
 - (2) landform (mesa, plain, terrace, etc.)
 - (3) slope, aspect and relief
 - (4) identify the drainage system and its streambed characteristics; identify stream names and orders
 - (5) map of stream orders*
- C. Topographic features (7 1/2 minute quad or better, if available).
- D. Literature cited.
- E. Summary.

* A map showing stream orders is useful in the description of stream patterns. It has a potential use in the reclamation plan and it indicates the intensity of the drainage network needed to drain the area after mining.

3. GEOLOGY

- A. General description of the regional geology, with map.
- B. Detailed description of the study area geology and map. *See face appears?*
(See Instruction #3, page 62).
- C. Describe the stratigraphy based on (geologic logs) to include the name, thickness, sequence, geotechnical properties and areal extent of all rock units penetrated by drilling. *bed*
(1) all coal seams including rider seams above the coal seam(s) to be mined. *bed*
(2) nature of the stratum immediately beneath the coal seam(s) to be mined.
(3) mineral resource other than coal.
(4) recreation areas of unique paleontology or unusual geologic conditions that signify scientific or recreational values.
(5) photographs.
- D. Description of geologic structure including engineering qualities and physical properties. *Attitude?*
(1) general altitude of strata (strike and dip).
(2) folding or local warping of strata.
(3) displacement of (faulting) within or near the study area.
(4) unstable areas. *F*
(5) sources of aggregate. *- ? for what purpose?*
(6) foundation conditions (rock, shrink-swell, etc.).
- E. Geologic hazards.
(1) landslides.
(2) earthquakes.
(3) subsidence. *B*
- F. Overburden thickness map.
- G. Description of the chemical properties of the overburden strata.* *Unstable*
(1) presence or absence of trace elements or (pollutants) by facies or formation rather than sodium, that affect plants, animals and man.
(2) presence or absence of sodium that affect reclamation based on (SAR, pH, EC, CEC and texture). *Unstable*
(3) table - chemical and physical characteristics.
- H. Prepare a figure of the representative cross-section of the land to be affected showing pertinent elevation (and location) of test borings and core samplings, and depicting the following information; the (nature) and depth of the various strata of overburden; the nature and thickness of coal or rider seams above the coal seam to be mined; the nature of the stratum immediately beneath the coal seam to be mined; all mineral crotlines and the strike and dip of the coal to be mined within the study area; the location of aquifers; and estimated elevation of water table. *Thickness?*
An estimate of the change in surface elevations assuming complete *Unstable*

* The intent is to be a discussion of overburden, not the overlying soil.

removal of the coal resource and replacement of backfill materials in an acceptable manner for reclamation.

1. Literature cited (to be placed at end of report). *References*
- J. Summary

INSTRUCTION #3

A *geologic* map of a scale which shall sufficiently show the following detail:

1. Outcrop areas of all mappable rock units with appropriate identification.
2. All mineral outcrop lines.
3. Dip and strike of the coal (to be mined).
4. Location of faults (if any), identification of downdropped side, and magnitude of displacement.
5. Location and land surface elevation of all test borings or core samplings.

6 *Total depth*

4. COAL RESOURCES

- A. Description of coal sections (seams) based on geologic logs (unless described in Section 3, c., Geology).
- B. Coalbed map showing coal outcrop lines and the areal extent of strippable coal to a predetermined depth (isopack map).
- C. Table - tabulation of coal resources estimate.
- D. Table - chemical properties for all coal seams more than 12 inches thick.
 - (1) proximate analysis - volatile material, fixed carbon, ash, moisture, ~~phosphorus~~. *Not proximate - ultimate*
 - (2) ultimate analysis, sulfur, carbon, hydrogen, oxygen, nitrogen, Btu.
 - (3) major and minor oxides and trace elements, composition of coal by coal beds.
- E. Graphic description of analytical data.
 - (1) vertical - plotted from geologic logs.
 - (2) horizontal - plan view, if significant.
- F. Brief description of the methodology and procedures used.
- G. Literature cited.
- H. Summary

Note: The contractor will supply USGS geologic logs and geologic maps, geologic cross sections, overburden thickness maps and coal samples for analysis.

5. SOIL AND OVERBURDEN MATERIAL

The primary intent of this section is to report the suitability of the soil and the underlying overburden material as a plant growth medium. Other soil/overburden data important to strip mined land reclamation. Example (trace elements) the soil inventory will be evaluated separately from the underlying overburden, excluding the coalbeds. Other interpretations made for soils are necessary to effectively plan and manage the resources in the pre-mining, during and post-mining periods.

A. Soil

A general description of the principle natural soil bodies that include the following:

- (1) physiography, relief and drainage.
- (2) parent material.
- (3) general profile characteristics including chemical, physical properties, and kind of vegetative cover.
- (4) extent.
- (5) associated soils.
- (6) suitability as a plant growth media for mined land reclamation.

B. Soil inventory

- (1) soil inventory map and legend.
- (2) table - soil chemical and physical data including those that affect the soil suitability as top dressing.
- (3) soil mapping unit description (acres and percent of area).
- (4) description of representative soil series.
- (5) soil interpretation for specific uses.
- (6) determination of soil erosion class by soil taxonomic unit within a soil mapping unit. (SSF).
- (7) table - soil taxonomic classification.
- (8) literature cited.

C. Overburden suitability

- (1) brief description of overburden material (solid core) with emphasis on characteristics important to reclamation.
 - (a) physical characteristics
 - (b) chemical characteristics
 - (c) accessibility
- (2) suitability for use a planting media in reclamation.
 - (a) specifications used.
 - (b) methods, basic data used, and limitations to projection of data.
 - (c) summary of overburden suitability.
- (3) additional assessments required of bedrock before mining.
- (4) identification of toxic materials.

D. Evaluation of available water supply.

E. Literature cited.

LAND AND OVERBURDEN MATERIAL (Alternative)

Refers to land classification to be used by USDI-Bureau of Reclamation only.

- A. Description of principal natural soil bodies.
 - (1) topography, vegetation, rock cover, etc.
 - (2) parent material.
 - (3) general profile description.
 - (4) physical characteristics.
 - (5) chemical characteristics.
 - (6) extent.
 - (7) associated soil series, if applicable.
 - (8) general suitability for use in surface-mined reclamation.
- B. Description of land classification survey
 - (1) specifications.
 - (2) description of land classes used.
 - (3) field procedures and laboratory support.
 - (4) results.
 - (a) description of mapped subclasses and extent.
 - (b) general map of classification results.
 - (c) general maps of significant major land factors significant to reclamation of surface-mined areas.

6. VEGETATION

- A. Present vegetative characteristics by soil-plant community.
 - (1) species composition by percent and productivity.
 - (2) rare and endangered plant species present.
 - (3) percent of soil surface under vegetative cover.
 - (4) soil-plant community identified and mapped on aerial photographs.
- B. Potential vegetative characteristics of soil-plant community under natural conditions (Climax).
 - (1) species composition by percent and productivity.
 - (2) rare and endangered plant species that would be present, if climax.
 - (3) percent of soil surface under vegetative cover.
- C. Native species to use in reclamation and successional trends.
- D. Literature cited.
- E. Summary

7. SEDIMENTS

- A. Compilation of sediment discharge records available from existing stations in the region.
- B. Sediment source area map for upland drainage basins in the report area.
- C. Evaluation of stream channels to establish estimate of sediment conveyance to downstream reaches.

- D. Estimates of sediment delivery ratios from 2 and 3 above.
- E. Map of soil detachability (erodibility) using indexes from laboratory tests on field samples of soils.
- F. Estimates of sediment yields from unreclaimed spoils.
- G. Estimates of effects of reclamation on sediment yield with time.
- H. Results of rainfall-simulator studies on undisturbed areas and disturbed areas in the principal soil-plant communities of the region.
- I. Literature cited.
- J. Summary

8. HYDROLOGY AND WATER SUPPLY

- A. Surface waters
 - (1) amount of water
 - (a) mean annual
 - (b) long-term water supply and flow duration
 - (c) seasonal variations
 - (d) rare events
- B. Subsurface water
 - (1) depth and quality of water-bearing strata
 - (2) direction, rate and estimated volume of flow-through aquifers
 - (3) results of pump tests performed
 - (4) location of ground water recharge and discharge
 - (5) potentiometric surface map
 - (6) potential water supply for reclamation
 - (7) problems and/or benefits of ground water condition
- C. Effects of mining on area hydrology
 - (1) potential effects on surface and subsurface water supplies
 - (2) drainage and pollution hazards that could result from mining
 - (3) effect on aquifers, springs and wells disturbed by mining
 - (4) measure required to prevent adverse effects of surface mining on surface and ground water of the area
- D. Continuing water studies related to the study area.
- E. Recommendations for additional study needs.
- F. Evaluation of available water supply for use in revegetation and reclamation of the study area.
- G. Reporting procedure - see Instruction #4, page 66.

INSTRUCTION #4

The first report to be part of the Reclamation Study Area Report, is due within one year of the initiation of the study. In the first report, USGS-WRD will furnish the contractor preparing the study area report with any data that has been collected, a brief description of the instrumentation network, with maps, hydrologic parameters collected, frequency of sampling, the kinds of interpretation needed and provide an estimated completion date of hydrologic study.

The second phase of reporting will be periodic data supplements provided upon request. There shall be frequent dialogue between USGS project personnel and BLM District personnel concerning 1) progress, 2) tentative conclusions and 3) change in the study.

The third and last phase of the report shall be an interpretive report provided for the BLM by the USGS on agreed-upon data. Indicate the need for continuing studies or changes to meet the requirements of the objective.

9. WILDLIFE

- A. Classification into standard physiographic region.
- B. Major plant and animal associations.
- C. Plant community.
 - (1) list of plants and animal species by composition
 - (2) list of key plant species
 - (3) vegetation patterns
- D. Description of special areas to wildlife (key areas).
- E. Probable effect on wildlife (both on and off-sites) during and after mining.
- F. Identify probable significant wildlife conflicts with minerals program development.
- G. Identify the probable plant community to be established based on the reclamation plan.
- H. Identify the probable returning animals and population after reclamation. Specifically, impacts associated with wildlife conflicts with the minerals program development and recommend reintroductions or introductions of potential wildlife species based on potential plant community or proposed introductions. Include potential wildlife habitat for threatened and endangered species.
- I. Identification of wildlife habitat management potential and a discussion of habitat management practices to be incorporated.
- J. Literature cited.
- K. Summary

10. CULTURAL RESOURCES

- A. Class I inventory and location map for the region. Indicate what is known culturally about the area.
- B. Class II inventory and map for the study area. Identify significant (SI) cultural resources within the area.
- C. Class III inventory for earth disturbance areas (drill holes, roads, etc.). Identify all cultural resources within area.
- D. Evaluate the significance of the cultural resources identified on the study area.
- E. Further considerations needed to avoid known significant cultural resources on the study area.

11. PALEONTOLOGY

- A. Inventory of known resources.
 - (1) map - photos
 - (2) narrative
 - (3) entire coal resource area
- B. Extensive search for the unknown sites
 - (1) maps
 - (2) reports
 - (3) ground search
 - (4) extensive testing
 - (5) study area only
- C. Intensive search and testing
 - (1) maps
 - (2) reports
 - (3) earth disturbance areas prior to major excavation

12. VISUAL RESOURCES

Impact on Visual Resource (BLM 6320).

- A. Exploration - (action, size, volume, methodology, equipment, location, type).
 - (1) (a) landform modification
 - (b) vegetation manipulation
 - (c) structure addition
 - (2) does it meet VRM contrast rating requirement for VRM class assigned to the area, short-term or long-term?
 - (3) recommendation to meet VRM class for analyses of visual resource impact
- B. Development
 - (1) (a) landform modification
 - (b) vegetation manipulation
 - (c) structure addition
 - (2) does it meet VRM contract rating requirement for VRM class assigned to the area, short-term and long-term?

- C. Production
 - (1) (a) landform modification
 - (b) vegetation manipulation
 - (c) structure addition
- D. After rehabilitation, does the entire area meet the requirements for VRM class assigned to the area?
- E. Visual simulator and computer "seen area" analyses in areas identified as critical by the District Manager, may be helpful in determining long-range impacts.



PRESENT LAND USE

PRESENT LAND USE

List and quantify present land uses to the extent possible from BLM District Unit Resource Analysis.

Reference: Federal Register, Vol. 42, No. 178, September 7, 1977, part 715.13.



OBJECTIVE

OBJECTIVE OF RECLAMATION

Planned land uses following mining.

1. Legal requirements of mined-land reclamation.
 - A. Federal
 - B. State
 - C. Local
2. BLM District's Management Framework Plan
3. Identify limitations and potentials.

The contractor shall identify the limitations and potentials that may be encountered should the area be leased for mining and actually mined. These limitations and potentials shall be addressed in light of the post-mining land uses and special physical profile data compiled as a result of this contract.

RECOMMENDATIONS FOR RECLAMATION...OR... POTENTIALS FOR RECLAMATION



This section can be written two ways dependent upon the identification of the post-mining use. Some argue this is not the case; therefore, it will be the decision of the BLM District and the contractor to agree on how this section is to be written.

Is it to be from a basis of recommendations or from a basis of potentials and limitations. Remember, what is written here can very well be lease stipulations and must be reasonable and practical.

The following gives guidance to choice made by BLM and contractor; first, Recommendations for Reclamation, and second, Potentials for Reclamation (Alternative).

RECOMMENDATIONS FOR RECLAMATION *no more*

When the ultimate post-mining land use has been determined through the BLM planning system (EMARS), then the following is applicable.

1. Actions during the pre-mining and mining period.
 - A. Identified ultimate potential land use; i.e., irrigated agriculture, urban development (subdivision), native range, timber production, wildlife, etc.
 - (1) capability of the basic resources of soil, water and plants, along with human needs, will largely determine potential land use
 - (2) consider feasible correction of basic resource limitations; i.e., fertilization, irrigation, introduced plant species, etc.
 - B. Determine optimum depth of topsoil needed to meet ultimate potential land use.
 - (1) for nonirrigated use, this depth is based on:
 - (a) effective rooting depth of native plants
 - (b) depth of mean annual soil moisture penetration
 - C. Determine volume of suitable topsoil available (based on soil depth and acreage).
 - D. Determine volume of topsoil substitute to borrow from the overburden.
 - E. Identify suitable overburden to be used as topsoil substitute (this is a team effort - geologist, soil scientist, hydrologist - to determine final placement of overburden).
 - F. Identify toxic overburden to be buried out of reach of plant roots and away from ground water aquifers.
 - G. Handle and dispose of water (surface and ground).
 - H. Determine shaping of spoil to retain aesthetics of area (reference BLM Manual 6320).
 - I. Provide proper conservation measures for the disturbed surface.
 - J. Additional studies to be made by mining company for final mine plan.
2. Post-mining operations or procedures for satisfactory reclamation of surface-mined area.
 - A. Planned land use.
 - B. Characterization of topsoil and spoil and evaluation for revegetation.
 - C. Topsoil suitability map.
 - D. Selection of plant species for seeding or transplanting.
 - (1) native plant species first consideration
 - (2) adapted introduced plant species second consideration
 - E. Determine nutrient deficiencies (NPK) and need for other additives to support desired plant communities.

- F. Irrigation requirements (omit if irrigation not recommended).
 - (1) system recommended
 - (2) length of time required
 - (3) suitability of available water supply
 - G. Preparation of area before planting.
 - (1) ripping or other operation to loosen compacted topsoil material
 - (2) surface cultivation - furrows, basins, etc.
 - H. Plant establishment - develop a plan to set forth the methods that include all or some of the following: direct planting of seeds, transplanting wildlings and bare root stock and planting of container-grown stock.
 - (1) time of planting and rates
 - (2) initial fertilizer applications - timing, amount, kind
 - (3) use of mulches, nurse crops, etc.
 - I. Special treatments such as gypsum, calcium chloride, etc., if needed.
3. Management of reclaimed area.
- A. Vegetative management plan.
 - (1) fertilization and/or soil amendment program
 - (2) irrigation rotation and withdrawal from watering (if irrigation is necessary)
 - (3) protection from wildlife and livestock
 - (4) permissible uses (grazing, recreation, etc.)
 - B. Conservation practices
4. Recommended alternative plans.

ASSUMPTION:

It is assumed that the stipulations attached to a coal lease will not, in themselves, be a mining or reclamation plan. Those stipulations will require the leasee to provide the detailed data in the area to be affected by mining. The detailed study should define the reclamation potential and problems of the lease tract and affected area. The leasee will then be held responsible, through lease stipulations, for developing an acceptable mining and reclamation plan. If problem areas are defined and the leasee cannot design an acceptable method of providing for the problems, then through lease stipulations that coal will not be mined.

POTENTIALS FOR RECLAMATION (ALTERNATIVE)

When the ultimate post-mining land use has not been determined for the proposed strip mine area, broad reclamation procedures will be jointly developed by the BLM District and contractor, assisted by USGS-Conservation Division, and incorporated into the report by the contractor. The intent is to identify potentials and limitations in mined land reclamation. Reasonable stipulations can be written based on what is known to gain additional site specific data for the reclamation plan portion of the mining plan as required in the rules and regulations.

1. Actions during the pre-mining and mining periods.
 - A. Selection of soil and overburden materials to be placed on surface as planting media.
 - B. Handling and placement of soil and overburden material.
 - (1) stockpiling of soil or overburden material proposed to be placed on the surface
 - (2) placement of material unsuitable for growing media
 - C. Placement and isolation of toxic materials.
 - D. Handle and dispose of water (surface and ground).
 - E. Determine shaping of spoil to retain aesthetics of area (reference BLM Manual 6320).
 - F. Provide proper conservation measures for the disturbed surface.
 - G. Additional studies to be made by mining company for final mine plan.
2. Post-mining operations or procedures for satisfactory reclamation of surface-mined area. See Checklist, page 79, for additional information.
 - A. Planned land use.
 - B. Characterization of topdressing and spoil and evaluation for revegetation.
 - C. Topsoil map.
 - D. Selection of species for seeding or transplanting.
 - (1) native species, first consideration
 - (2) adapted introduced species, second consideration
 - E. Determine nutrient deficiencies (NPK) and need for other additives to support desired vegetation.
 - F. Irrigation requirements (omit if irrigation not recommended).
 - (1) systems recommended
 - (2) length of time required
 - (3) suitability of available water supply
 - G. Preparation of area before planting
 - (1) ripping or other operation to loosen compacted material, if applicable
 - (2) surface cultivation - furrows, basins, etc.

- H. Plant establishment - develop a plan to set forth the methods that include all or some of the following: direct planting of seeds, transplanting wildlings and bare root stock and planting of container-grown stock.
 - (1) time of planting and rates
 - (2) initial fertilizer applications - timing, amount, kind
 - (3) use of mulches, nurse crops, etc.
 - I. Special treatments such as gypsum, calcium chloride, etc., if needed.
3. Management of reclaimed area.
- A. Vegetative management plan.
 - (1) fertilization and/or soil amendment program
 - (2) irrigation rotation and withdrawal from watering (if irrigation is necessary)
 - (3) protection from wildlife and livestock
 - (4) permissible uses (grazing, recreation, etc.)
 - B. Conservation practices.
4. Recommended alternative plans.

CHECK LIST - RECLAMATION OF SURFACE MINED LAND

The following shows the kinds of information needed for reclamation in a surface mining plan (minimum).

It is necessary to shape and grade the spoil (to replace topsoil or equivalent) and to protect the reshaped surface from deterioration. Surface dressing is that soil material above the coal seam that is determined to be suitable for establishing, supporting, and maintaining a permanent vegetative cover. The mitigation of the loss of existing topsoil by mining requires the following actions:

Present Environment

- (1) A map (1:24,000) showing the detailed location and extent of the surface soils capable of supporting vegetation with appropriate soil descriptions and associated chemical and physical data.
- (2) Diagrams or figures showing the depth from the surface and extent of overburden (geologic strata(s)) that are suitable of establishment supporting and maintaining vegetation with appropriate chemical data. This is necessary when existing natural soil qualities and quantities at the surface are deficient in the to-be-mined area.

Disturbed Environment

- (1) Planned land use (range, wildlife, cropland, etc.).
- (2) Stockpiling procedure and management.
- (3) Identification, location, and a plan for disposal of toxic layers with supporting chemical data.
- (4) Procedures for grading and shaping of the spoil, that include reduction of compaction before topsoil placement.
- (5) Procedures for replacement of topsoil and reduction of compaction.
- (6) Detailed surface dressing map after placement with supporting chemical and physical data to a depth of 60 inches.
- (7) Surface manipulations (seedbed preparation, terraces, basins, etc.).
- (8) Soil amendments and/or fertilizers and rates (gypsum, NPK, etc.).
- (9) Vegetative management plan (fencing, grazing plan, etc.).
- (10) Adapted species (native and cultural).
- (11) Time of seeding and rates.
- (12) Method of application of seed (broadcast, drill, etc.).
- (13) Management and protection.
- (14) Instrumentation (monitoring).

LITERATURE CITED

(TO BE ARRANGED BY DISCIPLINE)

GLOSSARY

(TO BE EXPANDED AS NEEDED)

Baseline data - a known quantity used as a control from which an inference or an argument is based.

Bedrock - any solid rock underlying soil, sand, clay, silt, and any other earthy materials.

Coal - a combustible rock containing more than 50 percent by weight and more than 70 percent by volume of carbonaceous materials (or distinguishable from black shales).

Core drilling - the process by which a cylindrical sample of rock and other strata is obtained through the use of a hollow drilling bit which cuts and retains a section of the rock or other strata penetrated.

Disturbed land - land on which excavation has occurred or upon which overburden has been deposited, or both.

Effective depth of soil - depth of soil to an inhibiting layer, i.e., bedrock, caliche, water table, distinctive contrasting layer, depth of moisture penetration; a chemical or physical barrier.

Evapotranspiration - a collective term meaning the loss of water to the atmosphere from both evaporation and transpiration by vegetation.

Ground cover - any living or dead vegetative material producing a protecting mat on or just above the soil surface.

Ground water - subsurface water occupying the saturation zone, from which wells and springs are fed. In a strict sense, the term applies only to water below the water table. Also called plerotic water; phreatic water.

Growing season - the season which in general, is warm enough for the growth of plants, the extreme average limits of duration being from the average date of the last killing frost in spring to that of the first killing frost in autumn. On the whole, however, the growing season is confined to that period of the year when the daily means are above 42°F.

Land classification - classification of specific bodies of land according to their characteristics or to their capabilities for use. A use capability classification may be defined as one based on both physical and economic considerations according to their capabilities for man's use, with sufficient detail of categorical definition and cartographic (mapping) expression to indicate those differences significant to men. Reference: Bureau of Reclamation.

Mined-land - land with new surface characteristics due to the removal of mineable commodity by surface mining methods and subsequent surface shaping and revegetation.

Overburden - material of any nature, consolidated or unconsolidated, that overlies a coal deposit, excluding topsoil which overlies the coal to be mined.

Post-mining land use - that use which will be made of affected lands after mining and reclamation is completed and which is specified in a mining or exploration plan approved pursuant to 30 CFR 211.

Reclamation - the process of returning affected lands to a stable condition and form consistent with their precursing productivity and use, or other approved post-mining land use.

Revegetation - the emergence, continued growth, and sustained productivity, and achievement of long-term natural succession of vegetation, as determined by a qualified scientist, suitable to the approved post-disturbance land use for the land surface. Includes seeding, planting, and measures taken to support stable vegetative growth such as fertilization, cultivation, mulching, irrigation, and harvesting where these support measures are required to achieve the vegetative cover required by the approved plan. Vegetation is considered successful when demonstrated to be durable and to meet the requirements specified in the plans for post-disturbance land use in terms of density, productivity, diversity, species, succession and which shows no signs of a typical disease or future change.

Soil - natural bodies on the earth's surface, in places modified or even made by man of earth materials, containing living matter and supporting or capable of supporting plants out-of-doors.

Surface mining - mining method whereby the overlying materials are removed to expose the mineral for extraction.

Topsoil - the A-horizon and underlying unconsolidated materials including those portions of the B and C soil horizons that have properties capable of producing desirable vegetation.

APPENDIX

(TO BE ARRANGED BY SUBJECT)

Bureau of Land Management
Library
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